

MORPHOLOGY OF *ADANSONIA DIGITATA*

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SUMMARY : The aestivation of corolla of *Adansonia digitata* is clearly contorted (regularly twisted), all the five petals in one flower veer clockwise and in another, counter-clockwise. As in most species of *Bombacaceae* and *Malvaceae*, the left-twisting and right-twisting flowers in any tree are distributed equally. The number of stamens per flower of *A. digitata* varies from 721 to 1 600. A right-twisting flower, on an average, bears a greater number of stamens than a left-twisting flower. Sizes of dry- and water-soaked pollen grains were measured.

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INTRODUCTION

Adansonia digitata L. comes under the exclusively tropical family of *Bombacaceae* (RENDLE, 1959). *Adansonia* is named after Michael ADANSON (1727-1806), a French naturalist. The genus has 10 species distributed in Africa and Australia (BAILEY, 1966). *Adansonia digitata* is native to tropical Africa. Species such as *A. madagascariensis* are endemic in arid regions of western Madagascar. *A. gregorii*, prevalent in Australia, has greater affinity to the African *A. digitata*. RICHARDS (1948) described it as one of the Sudanian trees. He divided the African forests into different zones. According to him, *A. digitata* is included in the common trees of Northern Guinea savannahs which fall under the Sudan Zone. The commonly met trees are *Lannea unicarpa*, *Balanites aegyptica*, *Combretum glutinosum*, *Sclerocarya birrea*, etc. *A. digitata* dominates the plains of Tropical Africa from the west coast along the southern border of the Sahara upto the region of East Africa (H. C. O. DE WIT, 1963). It is introduced in India by the Arabs (HOOKER, 1875). Good specimens of this species can be seen at Aurangabad and near Madras in the south. At the Alipore Zoological garden in Calcutta and the Indian Botanical Garden, Howrah, impressive *Adansonia* trees are growing, producing profuse fruits every year. In the campus of the Indian Statistical Institute, Calcutta some seedlings were planted of which one has started flowering from 1974. There are a few, long-fruited *A. digitata* growing at the Lucknow Zoo (RANDHAWA, 1965). None of the trees in India has developed the peculiar "inverted tree" like shape as one sees them in Africa.

It is interesting to note that the stamens of *Adansonia digitata* vary

greatly from flower to flower within a tree and between trees. The aestivation of corolla of the flowers of this species as typical of *Bombacaceae* is contorted, twisting clockwise or counter-clockwise (DAVIS, 1967). A striking observation made during the current investigations is that the flowers with counter-clockwise twisting corolla have a greater number of stamens. However, no right-twisting flowers were available from one tree. Stamens from flowers of five different trees were counted and all showed the same trend. Measurements of pollen grains were also repeated.

BRIEF MORPHOLOGY

Adansonia, though not a very tall tree, is the heaviest of the bombacaceous trees as its trunk is grotesquely thickened, often upto 30 feet (Pl. 1). Sometimes it grows even upto a diameter of 40 feet, and there are such stout trees in existence which are estimated to be 1,000 years old. In 1750, ADANSON attributed an age of 5,150 years to a particular tree growing at the mouth of the Senegal river. DE WIT (1963) remarked that probably ADANSON was over-generous here. The tree takes a mushroom like appearance for the widely placed horizontal branches. As it thrives in almost desert-like places, it has developed a peculiar morphological adaptation to reserve water in the hollow of its trunk. The trunk becomes hollow inside with the advancement of age. It is believed that it can contain as much as 250 gallons of water even in this way, and thus, old trees are helped to survive periods of drought (BENTHALL, 1946). The bark is fibrous and very tough, which protects the inner water-reservoir (LORUS & MILNE, 1967). Wood is quite light and soft and so not suitable for carpentry work. Sometimes the bark is used as a raw material for making rope and rough cloth. The central hollow space is often used as a room by cutting open a small door-way on the thick wall (SANTAPAU, 1966). During drought, large mammals penetrate the stem by the tusks to get the moisture present inside.

The wide branches bear large palmate, entire leaves during the rainy season. But the leaves are shed soon afterwards to appear again in May next only. Flowering season is June-July and goes upto August in Calcutta. Flowers are large, white and pendent on a long thick peduncle (Pl. 2). They bloom at midnight and turn brown by next mid-day and wither away by the evening.

Sepals are divided into five prominent parts and this protects the other inner floral members especially in the bud stage (Pl. 2; 3; 1). They are leathery and silky-to-hairy within. Petals are 5 and contorted or regularly twisted (Pl. 3, 2). All the petals in one flower twist clockwise, and in another, counter-clockwise. Stamens are many and crowded on the monadelphous staminal tube (Pl. 3, 3; 4). Anthers are single-chambered but folded in such a manner that they take the appearance of two-chambered anthers. The pollen grains are smooth. Ovary is 5-10-celled, style is long, passing through the staminal tube and keeping the stigmatic



Pl. 1. — Trunk of *Adansonia digitata* growing at the Indian Botanic Garden, Calcutta.

lobes in well-emerged, exserted position. Ovules are many. Fruit is oblong, woody, indehiscent with mealy acidic pulp inside containing reniform seeds embedded within the pulp (Pl. 2).

MATERIALS STUDIED

66 flowers (left- as well as right-twisting) were collected from five different trees of *Adansonia digitata* from Calcutta and were examined to determine their stamen numbers. The flowers were sorted out into left-



Pl. 2. — *Adansonia digitata* : 1-4, buds at stages of development and a bloomed flower; 5, young fruit; 6, mature fruit; 7, t.s. of fruit; 8, seeds with aril.

and right-twisting ones according to the aestivation of their petals, and their stamens counted.

The number of stamens per flower varied from 720.67 to 1 599.50 for the left-handed flowers, while from 764.33 to 1 359.83 for the right-handed flowers. It could be possible that the range would be wider still if some right-twisting flowers were available for tree n° 5 where the left-twisting flowers possessed the maximum number of stamens. The variance was calculated for the two kinds of flowers separately. The range of variance in the left-handed and right-handed flowers was also calculated. The variance for the left-handed flowers ranged between 1 165.42 and 26 330.17 but similar values for the right-spiralled flowers ranged between 1 200.32 and 9 808.89. The data are given in Table 1.



Pl. 3. — 1, Flowers of *A. digitata* showing fleshy gamo-sepalous calyx. Petals partially visible; 2, Flowers showing left-twisting (L) and right-twisting (R) corolla; 3, Filaments separating from monadelphous staminal tube.

TABLE 1

Adansonia digitata: NUMBER OF STAMENS PER FLOWER

TREE	N ^o OF FLOWERS	STAMENS PER FLOWER			
		left-twisting	variance	right-twisting	variance
1	12	720.67	1 165.42	764.33	1 200.32
2	20	1 055.20	8 396.76	1 086.90	9 808.89
3	20	1 037.00	2 625.60	1 084.70	1 441.21
4	12	1 345.17	26 330.17	1 359.83	9 151.54
5	2	1 559.50	7 656.25	nil	nil

Three flowers and three fruits from one of the trees growing within the Lucknow Zoo were also examined. The flowers (all right-twisting bore the following stamens:

Flower one	868 stamens
Flower two	942 stamens
Flower three	1 004 stamens
Mean per flower	938 stamens

The fruits of the trees at Lucknow are strikingly larger than those of any tree from Calcutta. But though the fruit is large, the seeds are lighter than those of Calcutta trees. The actual values are given in Table 2.

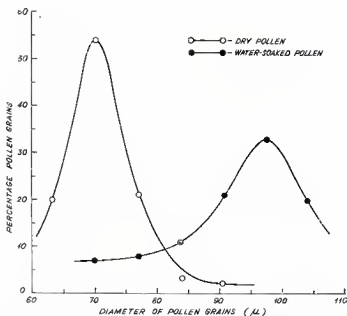
TABLE 2

Adansonia digitata: WEIGHTS OF FRUITS & SEEDS

CHARACTERS	FRUITS OF TREES FROM	
	Lucknow	Calcutta
Wt. of one fruit	252.5 gm	125.0 gm
Length of fruit	37.5 cm	21.5 cm
Maximum diameter of fruit	7.1 cm	7.0 cm
Wt. of 100 seeds	46.3 gm	59.8 gm



Pl. 4. — Flower of *A. digitata* and its organs : 1, whole flower; 2, petal; 3-4, staminal tube; 5-5a, stamen and anthers; 6-8, pollen grains; 9, gynoecium; 10-11, l.s. and t.s. ovary.



Pl. 5. — Distribution of dry and water-soaked pollen grains according to their size.

DISCUSSION

The pollen grains of *A. digitata* are of different sizes, varying from $63.27\ \mu$ to $90.63\ \mu$ in dry condition. The average diameter was calculated to be $70.76\ \mu$ on a sample of 100 pollens, and only 2 % of the pollens had the thickness of $90.63\ \mu$. The percentage distribution of pollen grains in dry and water-soaked conditions is given in Pl. 5. In a previous paper, DAVIS (1967) observed the average size of pollen to be $58.3\ \mu$ which is a much smaller value in comparison with the present finding. The difference must be due to some variation between trees. This becomes more pronounced if the increase in diameter due to soaked condition is considered. The soaked pollens recorded earlier measured $71.5\ \mu$ and the percentage of enlargement was found to be 22.7. In the present case, however, 33 % of the pollen grains were $97.47\ \mu$ thick, 20 % of them were $104.31\ \mu$ thick and 21 % were $90.63\ \mu$ thick. So, on an average, 74 % of the total pollen grains showed thickness ranging between $90.63\ \mu$ to $104.31\ \mu$. So it is clear that 75 % of the dry pollens enlarged to $90.63\ \mu$ to $104.31\ \mu$. The percentage enlargement is 29.36. On an average, among 100 pollen grains, it was observed that the dry pollens increased from $70.76\ \mu$ as diameter to $92.34\ \mu$ thereby recording a 30 % expansion.

BIBLIOGRAPHY

- BAILEY, L. H. — Manual of cultivated plants, Macmillan Company, 667 p. (1966).
BENTHALL, A. P. — The trees of Calcutta and its neighbourhood, Thacker Spink & Co. Ltd. : 45-47 (1946).
DAVIS, T. A. — Stamen number and pollen size in levo- and dextro-rotatory flowers of *Bombacaceæ*, Rev. Palaeobotany. Palynol. 3 : 133-139 (1967).
DE WIT, H.C.D. — Plants of the World, The higher plants, I. Translated by A. J. POMERANS, Thames and Hudson (London) : 260-261 (1963).
HOOKER, J. D. — Flora of British India, 1, Oxford, 348 p. (1875).
LORUS & M. MILNE. — Living plants of the World, Thomas Nelson & Sons Ltd., 148 p. (1967).
RANDHAWA, M. S. — Flowering trees, National Book Trust, India : 133-134 (1965).
RENDLE, A. B. — The classification of flowering plants, 2, Cambridge University Press, 254 p. (1959).
RICHARDS, P. W. — The tropical rainforest, Cambridge University Press, 337 p. (1948).
SANTAPAU, H. — Common trees, National Book Trust, India : 15-19 (1966).

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